

**DISCRETE DYNAMICAL SYSTEMS EXAMPLES****Math 21b, O. Knill**

FINANCE: INTEREST RATE.

$$A(x) = 1.02x$$

BIOLOGY: POPULATION GROWTH.

$$A = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$$

Fibonacci recursion  $x_{n+1} = x_n + x_{n-1}$ .

$$A = \begin{bmatrix} 0 & 2 \\ 1 & 1 \end{bmatrix}$$

Lila Bush growth.

PHYSICS: SOLID STATE PHYSICS.

$$A = \begin{bmatrix} E & -1 \\ 1 & 0 \end{bmatrix}$$

solves time independent Schrödinger equation  $Hu = Eu$  which is  $u_{n+1} + u_{n-1} = Eu_n$ .

STATISTICS: MARKOV PROCESSES.

$$A = \begin{bmatrix} 0.8 & 0.1 \\ 0.2 & 0.9 \end{bmatrix}$$

Regular transition matrix for Wipf/Migros competition.

$$A = \begin{bmatrix} 0.6 & 0.1 & 0.5 \\ 0.2 & 0.7 & 0.1 \\ 0.2 & 0.2 & 0.4 \end{bmatrix}$$

MCI/ATT/Sprint customers.

ECOLOGY: DIFFUSION.

$$A = \begin{bmatrix} 0.7 & 0 & 0 \\ 0.1 & 0.6 & 0 \\ 0 & 0.2 & 0.8 \end{bmatrix}$$

Silvaplana, Sils, St Moritz lakes.

GEOMETRY: TRANSFORMATIONS.

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

shear.

$$A = 1/2 \begin{bmatrix} \cos(\pi/6) & -\sin(\pi/6) \\ \sin(\pi/6) & \cos(\pi/6) \end{bmatrix}$$

rotation dilation.

$$A = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$$

projection

$$A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

reflection

$$A = \begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$$

scaling transformation